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river, and at last, at our turning point, the bed is all rocky masses, four or five feet high, with the water rushing through by numerous channels. The canoes go through with ease, and we might have taken the boats up also, but we were told that further up the channels were much narrower, and there was a high degree of probability that we should get them smashed in coming down.

"We were on part of the slave-route from the Lake Nyassa to Quilwa (Kilwa), about 30 miles below the station of Ndonge, where that route crosses Rovuma, and a little further from the confluence of the Liende, which, arising from the hills on the east of the Lake Nyassa, flows into Rovuma. It is said to be very large, with reeds and aquatic plants growing in it, but at this time only ankle-deep. It contains no rocks till near its sources on the mountains, and between it and the lake the distance is reported to require between two and three days. At the cataracts where we turned there is no rock on the shore, as on the Zambesi, at Kebrabasa, and Murchison's Cataracts. The land is perfectly smooth, and, as far as we could see, the country presented the same flat appearance, with only a few detached hills. The tsetse is met with all along the Rovuma, and the people have no cattle in consequence. They produce large quantities of oil-yielding seeds, as the sesame, or gerzelin, and have hives placed on the trees every few miles. We never saw ebony of equal size to what we met on this river; and as to its navigability, as the mark at which water stands for many months is three feet above what it is now, and it is now said to be a cubit lower than usual, I have no doubt that a vessel drawing when loaded about 18 inches would run with ease during many months of the year. Should English trade be established on the Lake Nyassa, Englishmen will make this their outlet rather than pay dues to the Portuguese.

"We return to put our ship on Nyassa, by the Shiré, because there we have the friendship of all the people, except that of the slave-hunters. Formerly, we found the Shiré people far more hostile than are the Makonde of Rovuma, but now they have confidence in us, and we in them. To leave them now would be to open the country for the slave-hunters to pursue their calling therein, and we should be obliged to go through the whole process of gaining a people's confidence again.

"It may seem to some persons weak to feel a chord vibrating to the dust of her who rests on the banks of the Zambesi, and thinking that the path thereby is consecrated by her remains. We go back to Johanna and Zambesi in a few days. Kind regards to Lady M., and believe me ever affectionately yours,

"DAVID LIVINGSTONE."

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The second Paper read was—

2. *Survey of the Physical Condition of the Atlantic Sea-bed, with special regard to the Establishment of Telegraphic Communication between Europe and America.* By G. C. WALLICH, Esq., M.D.

IN support of the view that the amount and kind of information heretofore possessed by us regarding the bed of the Atlantic, are altogether inadequate to meet the requirements of Oceanic Telegraphy, Dr. Wallich called attention to the fact that, up to the present period, only one reliable line of soundings has been taken to the southward of N. lat. 55°; and in this line only 41 soundings

occur along the central deep-water area of 1300 miles; the unexplored intervals varying in extent from 30 to 70 miles. Laying stress on the purely arbitrary nature of the evidence on which it has been asserted that the sea-bed is free from those alternations of outline which characterise dry land, Dr. Wallich proceeded to show that continuous mountain ranges might be present within such intervals, and yet necessarily be overlooked; it being very obvious that the detection of a steep gradient must depend on more than one observation as to depth. Now, although no very sudden irregularities in outline can be deduced from a profile of the sea-bed based on such distant measurements, it is hazardous in the extreme to assume that they do not or cannot exist. The sounding of 100 fathoms reported by Lieutenant Sainthill, R.N., within about 32 miles of the position at which Captain Dayman reported a depth of 3000 fathoms, may be cited as one out of many examples in corroboration of this view.

Dr. Wallich then enumerated the various kinds of observations he deems essential in a Survey for Telegraphic purposes; the principal ones being directed towards the procural of accurate information regarding the depths of water, the nature and depth of the submarine deposits, and the temperature, density, pressure, and chemical constitution of the water at various depths. In order the more effectually to carry out these observations, Dr. Wallich has invented several new forms of apparatus, which he exhibited.

Passing on to the means requisite for carrying out his proposed method of survey, Dr. Wallich recommends that Government should specially equip two steamships; that these should sail in parallel courses, removed only two miles from each other; and that they should sound alternately, at intervals of 5 miles, on each margin of the two-mile longitudinal belt thus defined. Hence, whilst the interval between any two soundings on the same line could not exceed five miles (that is, taken by the same vessel under ordinary circumstances), there would only be an interval of two and a half miles between the soundings taken on alternate lines. Having indicated how an adequate exploration of dangerous or doubtful areas might be effected by approximating the soundings much more closely to each other, and taking advantage of information elicited at each step, he suggested that Captain Dayman's line of soundings should form, as it were, the base of operations, and be taken as the centre of the two-mile longitudinal belt to be surveyed. By this means the two-and-a-half-mile diagonal intervals would be again reduced by about a half, wherever one of Captain Dayman's soundings might chance to come into play.

With regard to the period requisite to complete such a survey, Dr. Wallich stated that, allowing, at a most liberal estimate, four hours for each sounding and its concomitant observation, and three sets of observations per diem, and reckoning the extent of the deep-water area to be scrutinised at 1200 miles; each ship would effect 240 soundings in eighty days. But further allowing fifty soundings for exceptional cases and lateral deviation if demanded; with forty days for coaling, and twenty-five during which the state of the weather might render it difficult or impossible to carry on operations successfully; the total number of days would amount to 165, or five and a half months. If, however, we reckon three hours, instead of four, as a fair average term for each set of observations, and four sets to be taken daily (all other conditions remaining the same), each ship would be enabled to complete its 300 soundings in 140 days, or five months. Under either circumstances, supposing the expedition to start between the 15th and 30th April next, as recommended, the survey would be completed before the middle of October at the very latest.

Summing up the benefits likely to accrue from this mode of survey, Dr. Wallich pointed out that we should have no less than 640 reliable observations upon an area of the Atlantic of which we know no more at present than can be gleaned from one-sixteenth of that number; and thus establish a basis upon which the contour of the entire basin of the Atlantic might hereafter be approximately mapped out. In conclusion, he said, the task is unquestionably arduous, and its execution may prove costly; but there it was staring us in the face: a task either to be grappled with manfully and mastered, or else to be left unfulfilled for our successors to carry out.

The PRESIDENT reminded the Society that Dr. Wallich accompanied Sir Leopold M'Clintock in his exploration, and had since published the results in natural history obtained by the expedition, by which he had thrown light on the nature of the animals found at the bottom of the sea, and on the great varieties of soils and subsoils which exist there. The ingenious instrument which he had invented and explained enabled him not only to tap the soft strata, but absolutely to bore the rocks at the bottom of the ocean. Seldom had they had a paper more directly connected with the highest objects of physical geography than the one which Dr. Wallich had brought under their consideration. He had properly told them that unless they make this preliminary survey before any attempts are made to lay down telegraph cables they may find themselves involved in great difficulties. Whether or not any adventurous persons chose to undertake this survey previous to laying down a cable, the Council of the Royal Geographical Society thought it was the duty of a great maritime nation like Great Britain to become as intimately acquainted as possible with the bottom of the sea between England and America, with the view of telegraphic communication being established on a sound basis.

REAR-ADMIRAL SIR EDWARD BELCHER said, as this was a subject more

immediately connected with surveying, he, as senior surveying-officer in England, felt it his duty to answer that portion of the paper. The project of Dr. Wallich would answer very well for a passage across the Irish Channel. But his experience in searching for shoals even within 100 yards of his own ship for six weeks and fourteen hours a day, and the difficulty of finding a rock no larger than the President's chair, led him to the conclusion that any such survey as that projected would cost an immense sum of money and entail an amount of labour which few men would be willing to undergo. At these great depths, while the lead was getting down the vessel might have drifted five, six, or ten miles. It frequently happened in crossing a line of soundings that the wind was blowing on one side, and the line ran out at the weather-beam of the vessel at such a rate that it was utterly impossible to get back again to the spot where the paying-out commenced. It appeared to him that the best course for laying down a cable was that of short lengths, carried from spot to spot, along a line of water where they would find, not the deepest soundings, but a muddy bottom and an absence of mountains and hollows. Such a line as was proposed a year or two ago, from the Hebrides or the Orkneys to the Faröes, thence to Iceland, and then to Greenland, could be laid down at a comparatively trifling expense, with less risk of losing any great portion of the cable, and with greater facility for making an accurate survey of the bottom; whereas to run a cable right across the Atlantic was a project which few telegraph authorities thought desirable. With respect to soundings, he had a long experience in the years 1835 and 1836, and a very accurate instrument was then produced, not only for bringing up the bottom, but also for determining the temperature at a great depth. That instrument was a cylinder within a cylinder, made of stout bell-metal, with a valve opening inwards by pressure at the bottom. The two cylinders, when they went down, slid close home to each other. At a depth of 1200 fathoms the action of the water would force open the valve, and fill the whole interior with water. As you drew the instrument up to the surface the expansion of the water inside was so great that it would burst the vessel but for the provision of the second cylinder, which, slipping out and elongating the internal chamber, doubled the space for containing the air evolved from the water. He used this instrument from the year 1836 to the year 1847 without any difficulty, and without the slightest derangement even of the delicate thermometers that were within. And as to bringing up soundings, he believed there were very few men who could show so many shells as he possessed, brought up from depths of 1200 and 1500 fathoms. He thought, before the question was mooted of applying to Government to carry out a line of soundings at an enormous cost, that they should seek the opinion of scientific men whether it was better to carry a line straight across the Atlantic, or to have four separate stations for the cable.

ADMIRAL ELLIOTT believed, if they carried out the plan proposed by Dr. Wallich and obtained an accurate description of the bed of the sea, that they would be no wiser with regard to the laying down of a telegraph-cable. It was idle to suppose that they could thread their way across the Atlantic in the way proposed, and avoid the mountains and hollows that might exist at the bottom. He believed if they were to carry on the survey for a hundred years that they would still have to run the same risks that at present beset the laying of the cable. Moreover, he agreed with Sir Edward Belcher that the proposed plan of sounding could not be carried out, and he should prefer the method recommended by that distinguished officer instead. To hold in abeyance any attempt to establish telegraphic communication with America until the ocean-bed throughout the entire distance had been accurately sounded would, in his opinion, be an error. Let them be satisfied with the information already obtained, and lay down the cable at once, and if it lasted only two years it would repay the outlay and confer a great public benefit. He did not think the failure of the last cable attributable to the irregularities of the sea-

bottom, but to the great weight of the cable, and to its not having been sufficiently tested before being put on board ship.

CAPTAIN SELWYN, R.N., said Captain Dayman's accurate surveys, on account of his diagrams not being thoroughly understood, had given rise to a supposition that a precipice existed off the shores of Ireland. It had fallen to his lot, in company with an officer of the Admiralty high in the Hydrographic Department, to measure the distance in miles between the soundings and the depth in fathoms. The result was, they arrived at the conclusion that the descent was a little less than the descent of Holborn Hill. Now, it could not be imagined that a cable could be injured by being laid on a descent of that kind. As the extreme depth was about a thousandth part of the extreme length, taking this at 1650 miles, it followed that the depth might be represented by the thickness of a sheet of foolscap paper compared with its length. If there existed anything to cause abrasion, it was utterly impossible to say where they were to avoid it, or where they were to seek it. If they once found a shoal in the ocean, they would have the greatest difficulty in ever finding it again. By no possibility could a man pass over a line which he had once surveyed, with a certainty that he was within five miles of it. Not the best instruments, not the most accomplished navigators, would enable them to find their way out of the fogs of Newfoundland with such accuracy as that. Therefore, it appeared to him they were combating theoretical difficulties, while they had before them real difficulties to be met with. Captain Selwyn alluded to some of these difficulties with respect to the laying of different kinds of cables, and then suggested a shorter route for the deep-sea line by making use of the Newfoundland Bank, which at a certain point, 300 miles this side of Newfoundland, had a depth of water varying from 30 to 200 fathoms.

After some remarks from MR. WEBSTER in favour of laying down the deep-sea cable as the most effective mode of ascertaining the nature of the ocean-bed, Dr. Wallich briefly replied in defence of the plan he recommended, and the Meeting was then adjourned.

*Fifth Meeting, Monday, January 26th, 1863.*

SIR RODERICK I. MURCHISON, PRESIDENT, in the Chair.

ELECTIONS.—*Lieutenant Francis Duncan, R.N.; Major Frederic John Goldsmid; Captain Edvard Menzant; the Rev. Frederick Trestrail; Major Quintus Vivian; John Gardiner Austin; Alfred Barry; Thomas Moseley Crowder; John Emslie; William Gillett; Charles Harvey; Moss Joshua; Frederic John Jourdain; George Macfarlane; J. A. Olding; Frederic John Walker; George C. Wallich, M.D.; Frederic G. A. Williams; and John Wright, Esqrs., were elected Fellows.*

ACCESSIONS.—Among the Accessions to the Library and Map-Rooms since the former Meeting were—'Journal of Landsborough's Expedition in Australia;' 'Mercantile Navy List for 1863;' 'Lees' 'Six Months' Season of the Tropics;' 'Ordnance Survey;' 'Map of Route from Kiachta to Pekin,' &c. &c.

EXHIBITIONS.—Several Japanese Native Maps were exhibited at the Meeting from the Admiralty, Lady Franklin, &c.